

**North Dakota Department of Health**  
**Mandan Remediation Project Closure Strategy**  
**DRAFT – January 20, 2010**

**Project Goals**

Goals for the Mandan Remediation Project include:

- Protection of public health.
  - Protection of public health will be accomplished by reducing concentration, total volume and mobility of any remaining petroleum hydrocarbon contamination and limiting personal exposure to any remaining contamination.
  - Specific cleanup levels for soil and soil vapor will not be established. The site will be remediated to the maximum practical extent possible and personal exposure will be limited through implementation of the Mandan Environmental Institutional Control Ordinance.
  - Health risk from a chemical contaminant is the product of the personal exposure level and the toxicity of the contaminant. If exposure is eliminated then the health risk is also eliminated, regardless of the toxicity of the contaminant. The Department believes that the Mandan Environmental Control Ordinance will be effective in limiting personal exposure and any remaining contamination will be significantly less than prior to remediation.
- Provide liability protection for property owners and lenders.
  - This has been addressed through legislation creating North Dakota Century Code §23-20.03-03.1, and implementation of the Mandan Environmental Institutional Control Ordinance.
- Eliminate, to the maximum practical extent, free phase product on water table.
  - This will be accomplished through operation of the Multi-Phase Extraction (MPE) liquid fuel recovery system.
- Reduce soil vapors to minimize risk of soil vapor intrusion into structures.
  - This will be accomplished through operation of the Soil Vapor Extraction (SVE) recovery system and Bioventing.
- Dissolved petroleum hydrocarbons in groundwater will not be directly addressed. This will not be necessary because:

- The area is served by Mandan public water system.
- Installation of private wells is prohibited by Mandan Environmental Institutional Control Ordinance.
- Historically, groundwater has not affected basements remaining within the project area, with the exception of the Law Enforcement Center, even during the high water table period of the mid-1990s. The basement of the Law Enforcement Center is currently being retrofitted with a groundwater control system which should protect it from groundwater intrusion.
- Dissolved phase groundwater contamination will be indirectly addressed by eliminating free product (the major ongoing source of new dissolved petroleum contamination) which will allow natural attenuation to continue as the primary remedial measure.

### **Site Remediation Strategy**

The Site Strategy Plan outlined a phased implementation approach for the remediation technologies installed at the site. Several criteria will be evaluated to determine when the remedial objectives have been achieved. The proposed phases and criteria are:

- Phase 1 – Combined MPE and SVE system operation. The closure criterion for MPE was originally asymptotic product recovery rates. An asymptotic recovery rate is one that has a diminishing rate of return and does not get quickly to an endpoint – in other words when the recovery rate levels off to a small percentage of the original recovery rate which could then last for a long time. With an asymptotic recovery rate it would still cost a significant amount to operate the system, with very little additional benefit towards cleaning up the site.

It has been difficult to directly determine the asymptotic recovery rate due to the configuration and operation method of the treatment system. Using free product thickness in wells in each manifold area is a more practical approach to determining the end point of Phase 1. The metrics to shut down combined MPE+SVE and switch to SVE-only are suggested as follows:

- *Criterion:* No MPE- recoverable free product measured in wells. It will be attempted to reduce the free product thickness to less than 0.02 feet. However in some wells or areas the MPE system may only be recovering a minimal amount of free product and yet not reduce the free product thickness to 0.02 feet in a reasonable period of time. If this occurs then the goal for free product thickness left will be 0.1 feet and may be considered to have reached a maximum practical reduction of free product, or that area may need targeted polishing measures discussed in Phase 4.
- *Locations:* Each operating manifold.

- *Monitoring Frequency:* Originally this was to be not less than monthly. However monitoring frequency for regular fluid level monitoring was changed to quarterly due to cost.
  - *Duration Required to Demonstrate Sustainability:* Up to six consecutive months (or two consecutive quarters) when water table elevations are less than approximately 1629 feet mean sea level (ft msl). The system will be offline when ground-water elevations are high.
- Phase 2 – SVE system operation. The closure criteria for SVE are asymptotic vapor recovery rates and the absence of verified odor complaints from downtown businesses prior to shutdown of the system. The exit strategy metrics that were established to appropriately document the existence of asymptotic vapor recovery rates are as follows:
- *Criterion:* SVE monthly mass removal rate in pounds per month per 100 standard cubic feet per minute of air flow.
  - *Locations:* Each operating SVE blower. Most area manifolds have their own blower, though there are a few that share a blower.
  - *Monitoring Frequency:* Originally this was to be not less than monthly. However monitoring frequency for regular monitoring was changed to quarterly due to cost.
  - *Target Parameter Thresholds:* Asymptotic vapor recovery rates during periods of acceptable ground-water elevations and vapor recovery rates that are less than 10 percent of system start-up recovery rates. Start-up rates for each individual SVE blower are not available so this may have to be estimated. Operational modifications (flow rate adjustment, pulsed operation, others as appropriate and warranted) may be considered to substantiate asymptotic recovery rates.
  - *Duration Required to Demonstrate Sustainability:* Up to six consecutive months (or two consecutive quarters) when water table elevations are less than approximately 1629 feet mean sea level (ft msl). The system will be offline when ground-water elevations are high.
  - *Odor Complaints:* Must be reported prior to system shutdown and verified by air monitoring as being caused by the BNSF diesel contamination.
- Phase 3 – Bioventing - continued flow of air through the subsurface to enhance biodegradation of fuel in the soil. The final remedial technology that will be implemented is bioventing. The closure criterion for bioventing is asymptotic oxygen respiration rates. The exit strategy metrics that were established to appropriately document the existence of asymptotic oxygen respiration rates are as follows:
- *Criterion:* Oxygen respiration rates.

- *Locations:* Selected biorespiration testing sites.
  - *Monitoring Frequency:* As warranted by project results, not less than biannually.
  - *Target Parameter Thresholds:* Oxygen respiration measurements are asymptotic.
  - *Duration Required to Demonstrate Sustainability:* Up to six consecutive months (or two consecutive monitoring events) when water table elevations are less than approximately 1629 feet mean sea level (ft msl). The system will be offline when ground-water elevations are high.
- Phase 4 – Targeted Polishing (MPE, SVE and/or Bioventing as needed). Targeted MPE, SVE and/or bioventing will be employed as necessary to address any discreet areas that require further remedial actions based on subsequent environmental monitoring results. Targeted polishing may include the injection of surfactants into the subsurface around a well where free product levels are not declining as quickly as other areas. The completion of the polishing phase will be at the discretion of the NDDoH with input from the MRT and LBG.

#### **Other Project Closure Activities**

- Follow up monitoring after shut down of final active remediation to verify effectiveness.
- Long-term monitoring along BNSF property boundary.
  - BNSF maintains 10 monitoring wells along the northern property line of the rail yard. They are required under the terms of the settlement to conduct monitoring to ensure that contamination that is currently beneath the rail yard does not migrate off site. The NDDoH will evaluate this data in conjunction with follow up monitoring in the downtown area prior to decisions on final shutdown and decommissioning.
- Decommissioning or abandonment of the system infrastructure. Recommendations for various components are:
  - Wells – plug and abandon per water well regulations.
  - Old horizontal SVE/sparging system – should be grouted or filled with bentonite slurry with the east and west ends cut off and capped below grade. If these horizontal lines are not grouted, especially the deep ones, they may provide a direct conduit for migration of any remaining or future subsurface contamination.
  - Deep lines – left in place. Cut off and capped below grade where they come to the surface.
  - Shallow gathering lines – left in place. Cut off and capped below grade where they come to the surface at each manifold building.

- Well vaults – removed and filled, with the surface cover replaced to match adjacent ground cover.
  - Manifold buildings – removed with all lines cut off and capped below grade.
  - Major remediation buildings – ownership transferred to City of Mandan for beneficial reuse or torn down, as best needed.
  - Remediation equipment – ownership transferred to City of Mandan for beneficial reuse or sold at public auction or discarded, as best needed.
- Establishment and release of financial assurance escrow account.
- How much money needs to remain in escrow for future potential cleanup activities as required by NDCC Section 23-20.3-03.1?
    - Money for follow up monitoring prior to final decommissioning of the system.
    - Money for utilities in buildings while inactive, but not yet decommissioned.
    - Money to operate the system, or a portion thereof, to address contamination discovered during follow up monitoring. Initial remediation period was expected to be three to five years. Additional time to address a “hot spot” that shows up would probably not exceed two years.
    - Money to decommission/abandon the system and buildings.
    - Cost estimates will be calculated and submitted by LBG.
  - How long before final site closure and release of escrow?
    - NDCC Section 23-20.3-03.1 does not specifically address the time period that financial assurance needs to be maintained.
    - At a minimum the escrow must held through the post-shut down monitoring period plus the time needed to decommission the system.
    - The Department may not be able to release the escrow as long as the State is liable for future impacts. This will have to be determined by the Attorney General.

### **Questions and Options**

- How clean is clean enough?
  - “Clean enough” is when the site meets the project goals of protecting public health, eliminating free product, minimizing soil vapor risk, and providing liability protection.

- There is not a specific standard, such as maximum soil petroleum concentration, that can be applied across the entire site. It is understood that there will be residual soil and dissolved groundwater contamination remaining after the project closes and that the residual may vary from area to area.
- What determines whether an area needs targeted “polishing”?
- Polishing or targeted remediation will be used primarily for pockets of free product. These can be readily identified by fluid level monitoring. The targeted remediation may include the injection of surfactants into the subsurface around a well where free product levels are not declining as quickly as other areas.
  - Targeted remediation can also be used in areas where excessive soil vapor is identified. It is not possible to be as well-specific for SVE monitoring as it is for free product monitoring, however SVE could be targeted to individual manifold areas. When overall vapor recovery rates reach asymptotic levels, that should be sufficient to implement the next phase, which is bioventing. Biorespiration rate testing is not performed in every manifold area due to cost, but is being performed in what will probably be the last, “worst” areas.
- Can some areas receive full shut-down before others? The two options are:
- Yes, shut down areas as soon as they meet the closure criteria. This would decrease costs to operate the system. It may also leave a more uniform level of remaining contamination across the site, because all areas will be shut down when they reach a final asymptotic oxygen respiration rate. This is the recommended option.
  - No, continue operating all areas until the entire site meets the closure criteria. The potential benefit is that incremental, though maybe not significant, reductions of contamination will continue. This option will cost more and may end up with some areas cleaner than others, when the final areas are deemed clean enough. This is not the recommended option due to increased O&M cost.
- How long to perform follow-up monitoring? Several options include:
- Continue to perform periodic fluid level monitoring through the bioventing phase. If significant free product of sufficient thickness to be practically recovered by the MPE system is encountered then targeted remediation can be restarted. MPE and bioventing can be performed simultaneously in different manifold areas. There are a few exceptions where more than one manifold share a blower.
  - Continue fluid level monitoring in all areas until the full site is “closed”. This could continue past shutdown of the bioventing phase for some period of confirmation monitoring. At many sites in the state the NDDH has used a post-remediation period of 2 years of follow-up monitoring to confirm that a site is stable. EPA’s final directive on

the use of monitored natural attenuation at superfund, RCRA corrective action, and underground storage tank sites states: “Typically, monitoring is continued for a specified period (e.g., one to three years) after remediation objectives have been achieved to ensure that concentration levels are stable and remain below target levels.” This is the recommended option for fluid level monitoring in the remediation area.

- BNSF is required to continue fluid level monitoring along the rail yard property boundary, which has not been remediated.
  - Biorespiration rate monitoring should be periodically performed in the last areas where significant free product was observed. When the oxygen respiration rate reaches an asymptotic rate for two consecutive monitoring events the bioventing phase should be complete.
- What would trigger re-activation of the system?
- Continued fluid level monitoring detected a significant level of free product where it previously had been eliminated. Action level would be an amount that can be practically recovered by the MPE system as described in the Phase 1 discussion. It is understood and expected that there may be areas with minor or trace amounts of free product remaining.
  - Vapor problems in a building if it was verified by air monitoring as being caused by the BNSF diesel contamination.
  - Other?
  - Initial action would be additional monitoring and assessment of the problem area to determine whether re-activation of the system would be necessary or beneficial, or whether some other mitigation measure would be effective.